

Seat No. _____

LAST NAME WST

FIRST NAME _____

There are 8 pages to this exam. Check to make sure you have a complete exam.

PLEASE ALSO PRINT YOUR NAME ON THE TOP OF
THE **BACK** OF THE LAST PAGE OF THE EXAM

CHEMISTRY 331

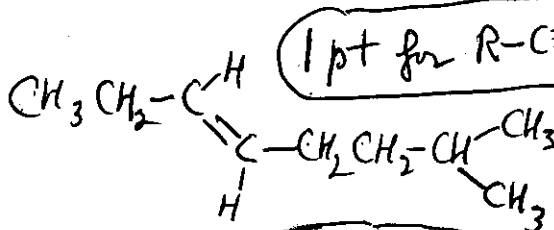
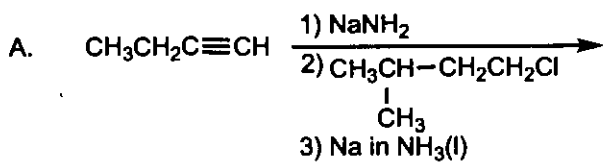
EXAM IV

Spring 2009, April 8, 2009

I.	(30 points)	<input type="checkbox"/>	<input type="checkbox"/>	_____
		A-E (15 pts)	F-J (15 pts)	
II.	(12 points)			_____
III.	(18 points)			_____
IV.	(14 points)	<input type="checkbox"/>	<input type="checkbox"/>	_____
		A (6 pts)	B,C (8 pts)	
V.	(12 points)			_____
VI.	(14 points)	<input type="checkbox"/>	<input type="checkbox"/>	_____
		A (7 pts)	B (7 pts)	
TOTAL	(100 points)			_____

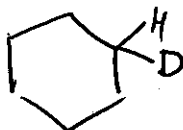
THE FINAL EXAM IS SCHEDULED FOR TUESDAY, MAY 5, FROM 7:30-9:30 A.M. ANY STUDENT WITH 3 EXAMS ON MAY 5 SHOULD E-MAIL THE CHEM 331 INSTRUCTOR BEFORE APRIL 20 WITH THE LIST OF COURSE CONFLICTS.

I. (30 pts) Complete the following equations giving all organic product(s). Stereochemistry must be clearly indicated in reactions which are stereoselective.

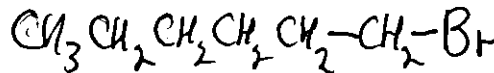
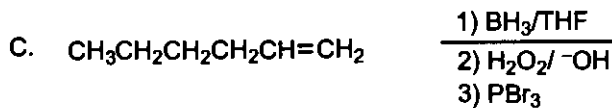


1 pt for $\text{R}-\text{C}\equiv\text{C}-\text{R}'$

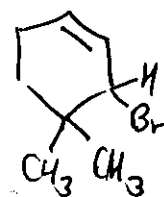
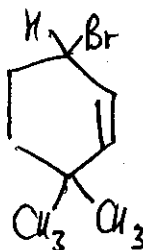
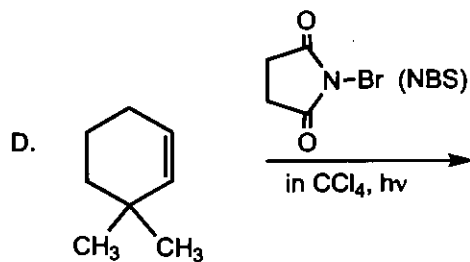
only 2 pts if not trans



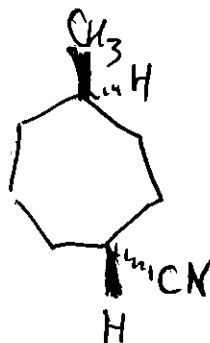
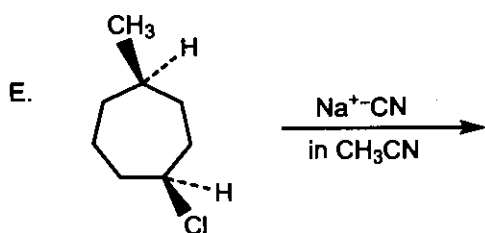
0 pts for 2 deuteriums in product



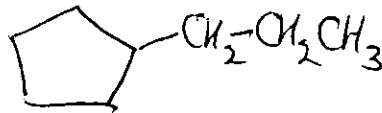
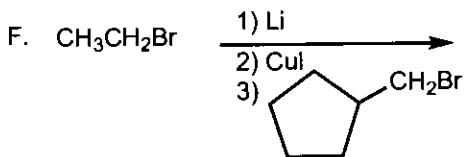
only 1 pt for $\text{R}-\text{CH}-\text{CH}_3$
 Br



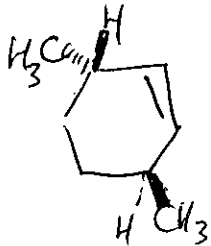
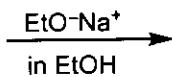
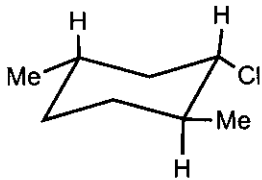
only 1 pt for isomer



only 1 pt if wrong or no stereochemistry



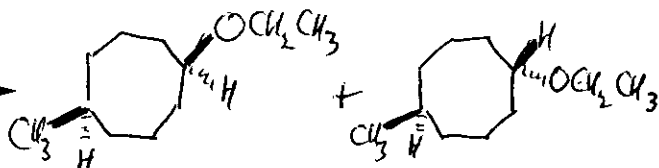
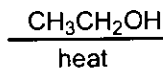
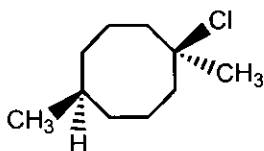
G.



only 1 pt if other constitutional isomer or both isomers

only 2 pts if wrong or no stereochemistry
[no O in product(s)]

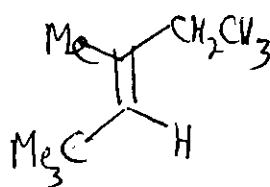
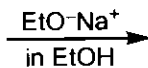
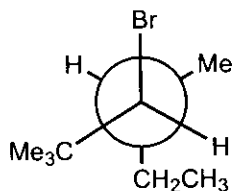
H.



[no sp^2 carbon atoms in product(s)]

only 1 pt if not both isomers

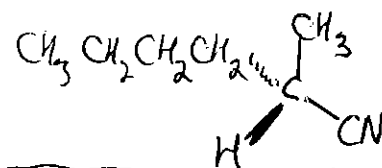
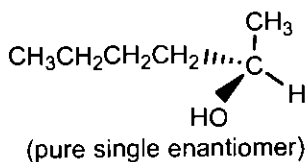
I.



only 1 point if wrong or no stereochemistry

[only one product; no O in product]

J.



1 pt for

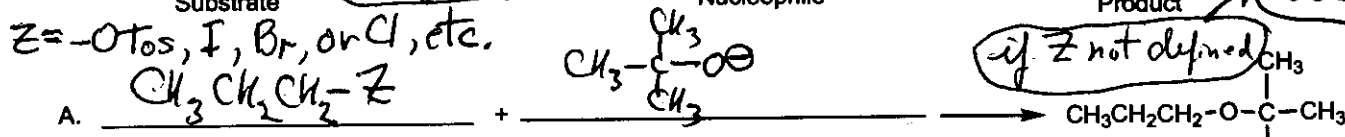
only 1 point if wrong or no stereochemistry

II. (12 pts) Prepare the following compounds by an S_N2 reaction by choosing a satisfactory substrate and nucleophile for each reaction (stereochemistry must be clearly indicated when necessary)

Substrate
 $Z = -OTos, I, Br, or Cl, etc.$

Nucleophile

Product

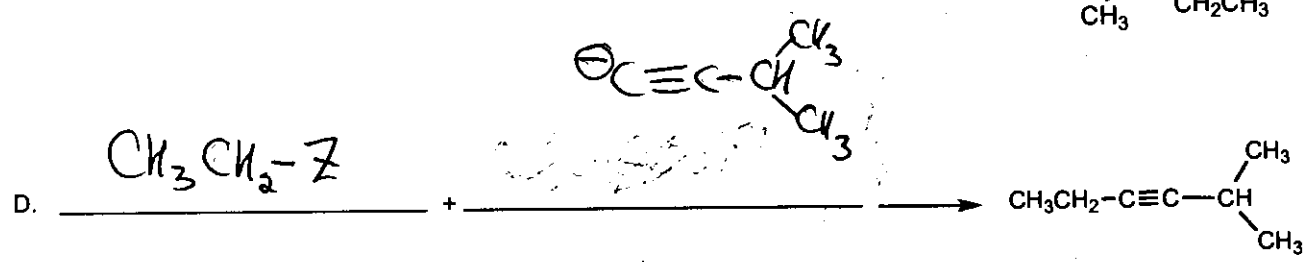
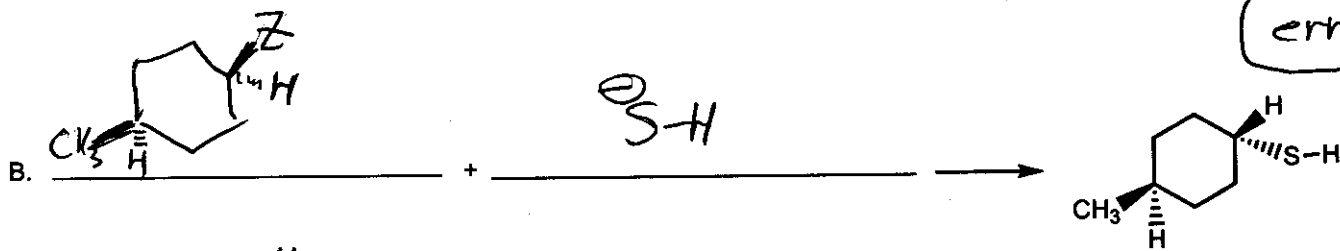


Only 1 point if one reactant is incorrect

-1 for use of Z

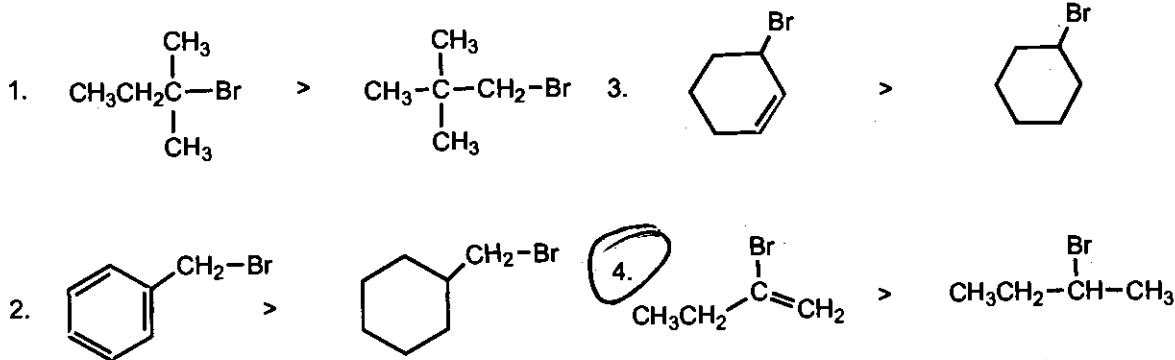
if Z not defined

-1 pt for minor error

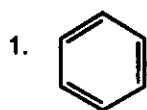


III. (18 pts) Circle the best answer.

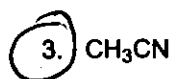
A. Which is NOT true for S_N1 relative reactivities?



B. Which of the following is the best solvent for S_N2 reactions?

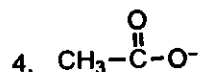
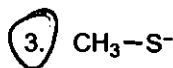
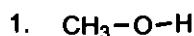


2. Hexane

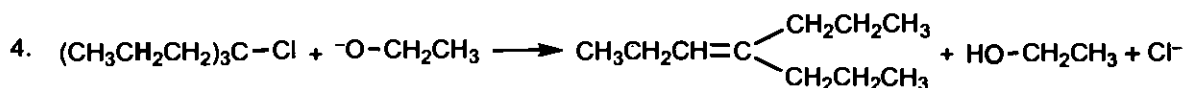
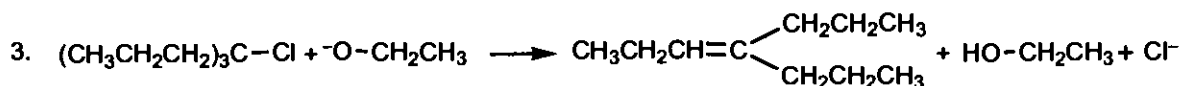
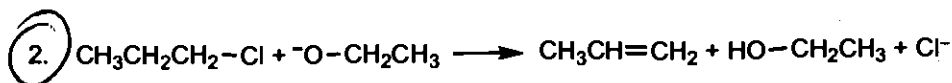
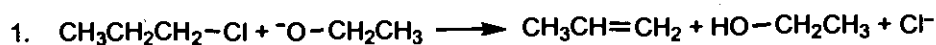


4. 70% H_2O , 30% $\text{CH}_3\text{CH}_2\text{OH}$

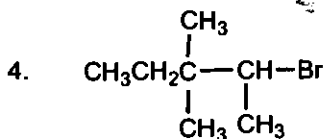
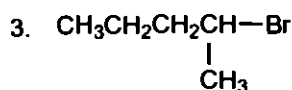
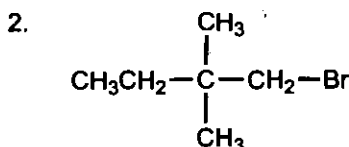
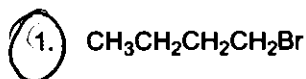
C. Which of the following is the best nucleophile in an S_N2 reaction?



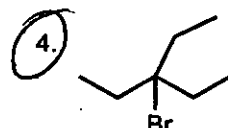
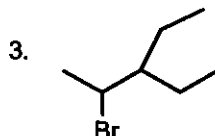
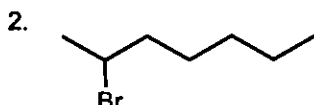
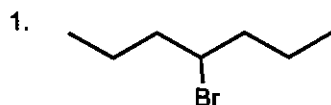
D. Which of the following reactions shows the largest deuterium isotope effect when the bold hydrogens are replaced with deuterium?



E. Which is the most reactive compound in an S_N2 reaction?

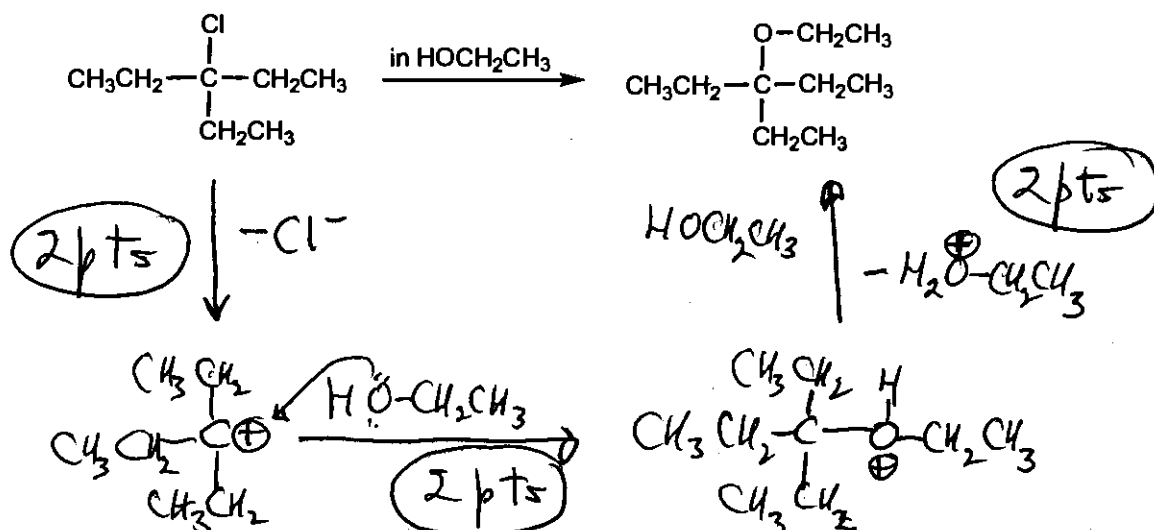


F. Which of the following compounds gives the smallest number of alkene products (count a pair of cis-trans isomers as two products) in an $E2$ reaction?

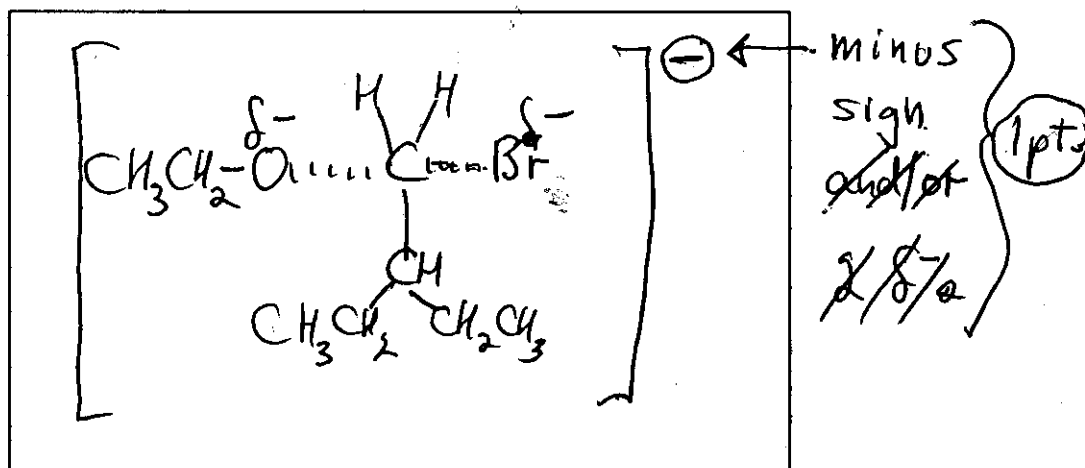
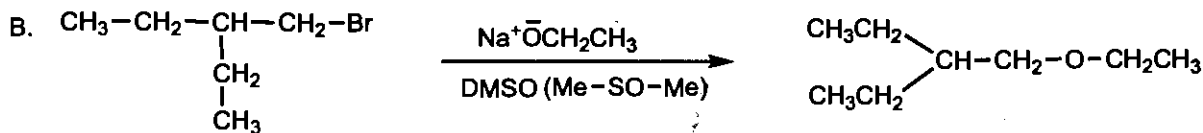


IV. (14 pts)

A. (6 pts) Give a reasonable mechanism for the following reaction.



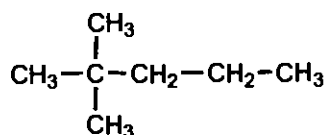
B. (4 pts) In the box provided draw the transition state (geometry must be clear) of the rate-limiting step of the following reaction.



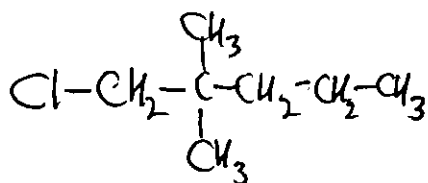
C. (4pts) Indicate whether the following statements are True or False by circling the T or F.

- T F 1. The rate of the reaction in Part A would be increased by adding $\text{NaOCH}_2\text{CH}_3$ to the reaction mixture.
- T F 2. The reaction in Part A should show 2nd order kinetics.
- T F 3. The reaction in Part B should show 2nd order kinetics.
- T F 4. The rate of the reaction in Part B would be increased by replacing the "-Br" with "-Cl".

V. (12 pts) If Cl_2 is used as the chlorinating agent in the light-induced chlorination of

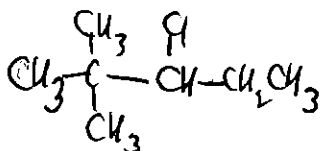


the relative reactivities (per hydrogen) for 1° , 2° , and 3° are 1 to 3.5 to 5 at 25°C . What will the relative proportions of monochloro products (constitutional isomers only) in the reaction mixture be? (Answers may be expressed in fractions). SHOW YOUR WORK. List the reaction products and the fraction of each formed.



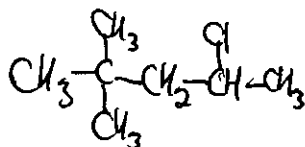
$$(9)(1) = 9$$

9/26



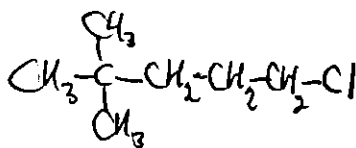
$$(2)(3.5) = 7$$

7/26



$$(2)(3.5) = 7$$

7/26



$$(3)(1) = 3$$

3/26

1 pt/structure

one pt/structure for
(# of H's) x (reactivity)

Periodic Table of the Elements

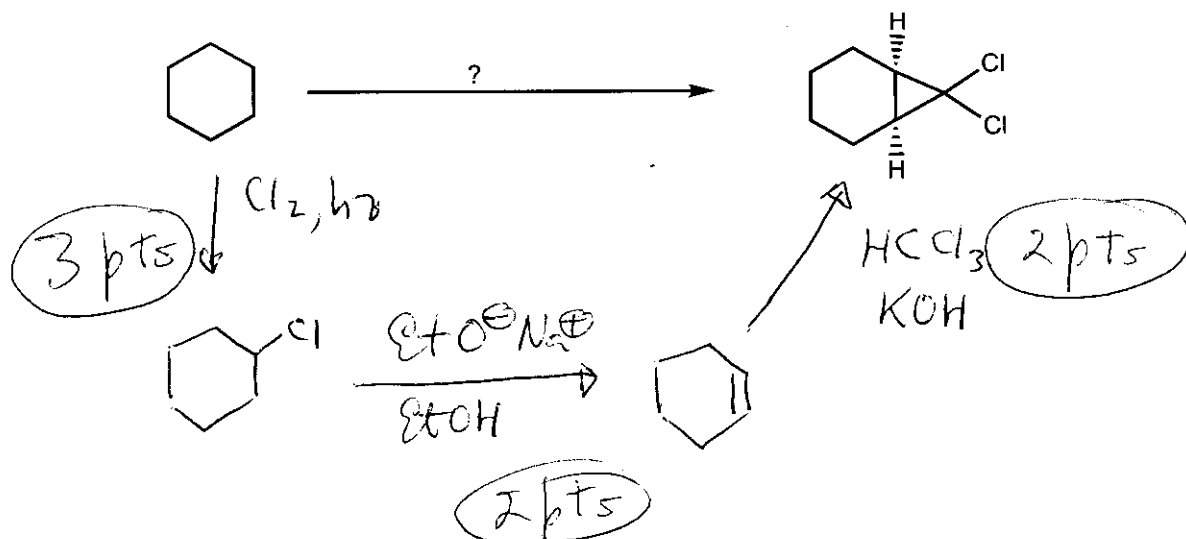
1 pt for (12)(1) and (4)(3.5)

1 pt/structure

1A 1 H 1.01	2A 2 He 4.00											3A 13 B 10.8	4A 14 C 12.0	5A 15 N 14.0	6A 16 O 16.0	7A 17 F 19.0	8A 18 Ne 20.2																		
3 Li 6.94	4 Be 9.01											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 39.9																		
11 Na 23.0	12 Mg 24.3	3B 3	4B 4	5B 5	6B 6	7B 7	8 8	9 9	10 10	1B 11	2B 12	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8																
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8	37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)	87 Fr (223)	88 Ra 226	89 Ac 227	104 Rf (261)	105 Ha (262)	106 Unh (263)	107 Uus (264)	108 Uno (265)	109 Uue (266)									

VI. (14 pts) Beginning with the starting material indicated, show how to achieve each of the following syntheses by showing all the reactions that are needed (for each reaction, give the starting material, conditions over the arrow, and the products). You may use any inorganic compound or organic compound with 2 carbons or fewer.

A. (7 pts)



B. (7 pts)

